SEE Test Report V1.0
Heavy ion SEE test of SAT8605R from SatCon Electronics

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I. Introduction

This study was undertaken to determine the single event destructive and transient susceptibility of the SAT8605R-53T-1.5 linear voltage regulator. The device was monitored for transient interruptions in the output signal and for destructive events induced by exposing it to a heavy ion beam at the Lawrence Berkeley Laboratory (LBL) Cyclotron Single Event Effects Test Facility. This test was performed in the frame of NASA NEPP project.

II. Devices Tested

The sample size of the testing is two devices. The test samples lot date code is unknown as there is no package marking on the test samples.

The device technology is bipolar. The device is packaged in a 5-lead metal MO-078 package. Test samples were provided by the manufacturer. Package lids were not seam welded, and lids were held in place with anti-static tape.

III. Test Facility

Facility: LBL Cyclotron Single Event Effects Test Facility, (10 MeV/u ion cocktail)
Flux: 1×10^3 to 1×10^5 particles/cm^2/s.
Fluence: all tests were run to > 1×10^6 p/cm^2 or until a sufficient (>100) number of transient events occurred.

The ions and LET values used for these tests are listed in Table 1.

Table 1: characteristics of ions used for the experiments (10 MeV/u cocktail)

Ion	Energy (MeV)	LET (MeVcm^2/mg)	Range (μm)
^{40}Ar	400	9.74	130
^{65}Cu	659	21.33	110
^{86}Kr	886	31.28	110
^{136}Xe	1330	58.72	97

IV. Test Conditions and Error Modes

Test Temperature: Room Temperature

Bias conditions Vin = 3.3V
Vout= 1.5V
Device under test (DUT) was biased as shown in Figure 1. Sense lines were not connected; therefore output voltage varied slightly in function of output current. Test conditions are presented in Table 2. Resistive loads were used.

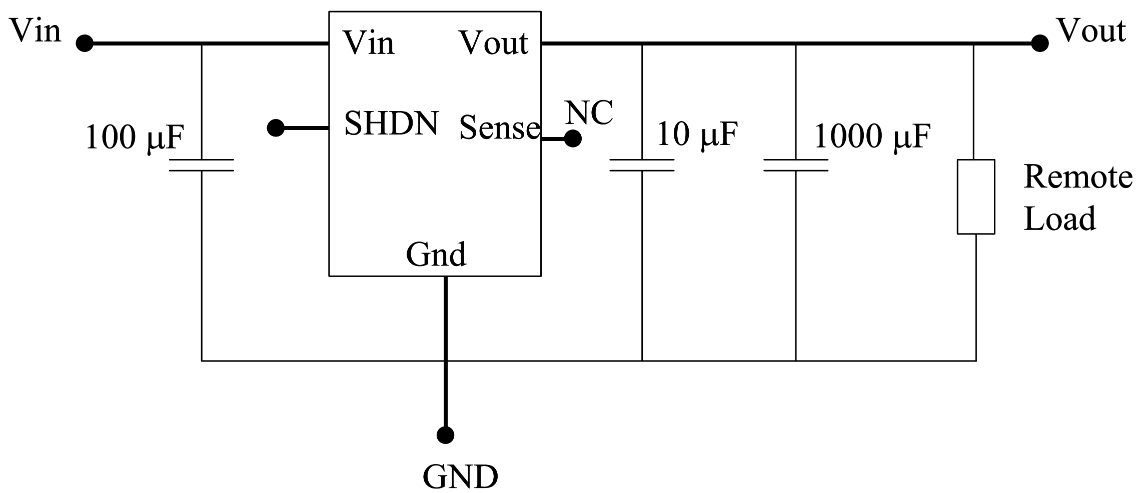

Figure 1: Bias conditions

Table 2: Test conditions

Vin (V)	Vout (V)	Iout (mA)
3.3	1.5	100
3.3	1.45	300
3.3	1.43	500
3.3	1.38	1000

PARAMETERS OF INTEREST: Power supply currents, output voltage

SEE Conditions: SEL, SEGR, SET

V. Test Methods

Test circuit, as shown in Figure 2, for the voltage regulator contains a power supply for the input voltage, a resistive load for drawing current, and a digital scope for capturing any output anomalies. Once the, programmable output is present and the load conditions are set, the digital scope is set to trigger on and voltages that are above or below a predetermined threshold (set to 75 mV).

Once the voltage regulator receives the input voltage, it produces a regulated output. The digital scope triggered for both voltage dropouts and over voltage conditions at the output terminal.

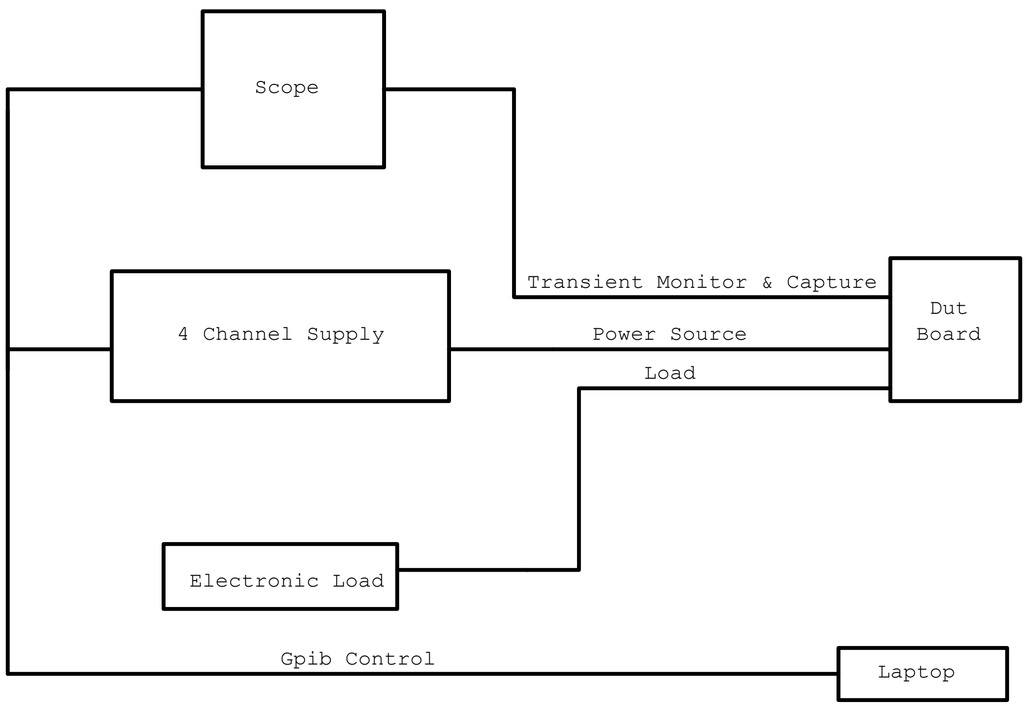

Figure 2. Overall Block Diagram for the testing of the SAT8605R.

VI. Test Results

Detailed test results are shown in Table 3. No destructive event was observed up to the maximum tested LET of 59 MeVcm^2/mg. SAT8605R has a moderate sensitivity to SET. Cross section versus LET plots are shown in Figure 3. Device is not sensitive to SET for low load currents (< 100 mA).

Table 3: test results

Run #	SN #	Iout (mA)	Ion	Tilt (˚)	Eff LET (MeVcm^2/mg)	Flux (#/cm^2-s)	Fluence (#/cm^2)	SET #	X SET (cm^2/dev)
105	1	300	Kr	0	31.28	1.00E+04	1.13E+06	0	0.00E+00
106	2	300	Kr	0	31.28	1.00E+04	1.08E+06	0	0.00E+00
107	2	500	Kr	0	31.28	1.00E+03	1.85E+05	85	4.59E-04
108	2	1000	Kr	0	31.28	1.00E+03	1.71E+05	117	6.84E-04
109	2	1000	Xe	0	58.72	1.00E+03	5.19E+05	104	2.00E-04
110	2	1000	Xe	0	58.72	1.00E+03	1.78E+05	41	2.30E-04
111	2	500	Xe	0	58.72	1.00E+03	6.09E+05	95	1.56E-04
112	2	300	Xe	0	58.72	4.00E+03	7.89E+05	98	1.24E-04
113	1	300	Xe	0	58.72	4.00E+03	8.23E+05	100	1.22E-04
114	1	100	Xe	0	58.72	1.00E+04	1.35E+06	0	0.00E+00
116	1	500	Xe	0	58.72	5.00E+03	6.17E+05	105	1.70E-04
117	1	1000	Xe	0	58.72	5.00E+03	5.85E+05	102	1.74E-04
126	1	1000	Cu	0	21.33	1.00E+04	2.20E+06	58	2.64E-05
127	1	500	Cu	0	21.33	1.00E+04	1.72E+06	144	8.37E-05
128	2	500	Cu	0	21.33	1.00E+04	1.76E+06	178	1.01E-04
129	2	1000	Cu	0	21.33	1.00E+04	2.18E+06	53	2.43E-05
130	2	300	Cu	0	21.33	4.00E+04	2.23E+06	116	5.20E-05
131	2	100	Cu	0	21.33	1.00E+03	9.65E+05	0	0.00E+00
132	2	300	Cu	0	21.33	1.00E+03	1.10E+06	59	5.36E-05
133	2	500	Cu	0	21.33	1.00E+03	9.87E+05	95	9.63E-05
134	2	1000	Cu	0	21.33	1.00E+03	1.05E+06	28	2.67E-05
135	2	1000	Ar	0	9.74	5.00E+03	1.00E+06	0	0.00E+00
136	2	500	Ar	0	9.74	5.00E+03	1.05E+06	0	0.00E+00
137	2	300	Ar	0	9.74	5.00E+03	1.04E+06	0	0.00E+00
138	1	500	Ar	0	9.74	4.00E+03	1.00E+06	0	0.00E+00
139	1	1000	Ar	0	9.74	4.00E+03	1.00E+06	0	0.00E+00

All SETs have similar waveform. Typical transient waveforms are shown in Figure 4. Figure 5 shows the transient amplitude versus widths plot of all transients collected during run 113. Maximum measured transient amplitude is 450 mV, and maximum transient full width at half maximum (FWHM) is about 6 μs.

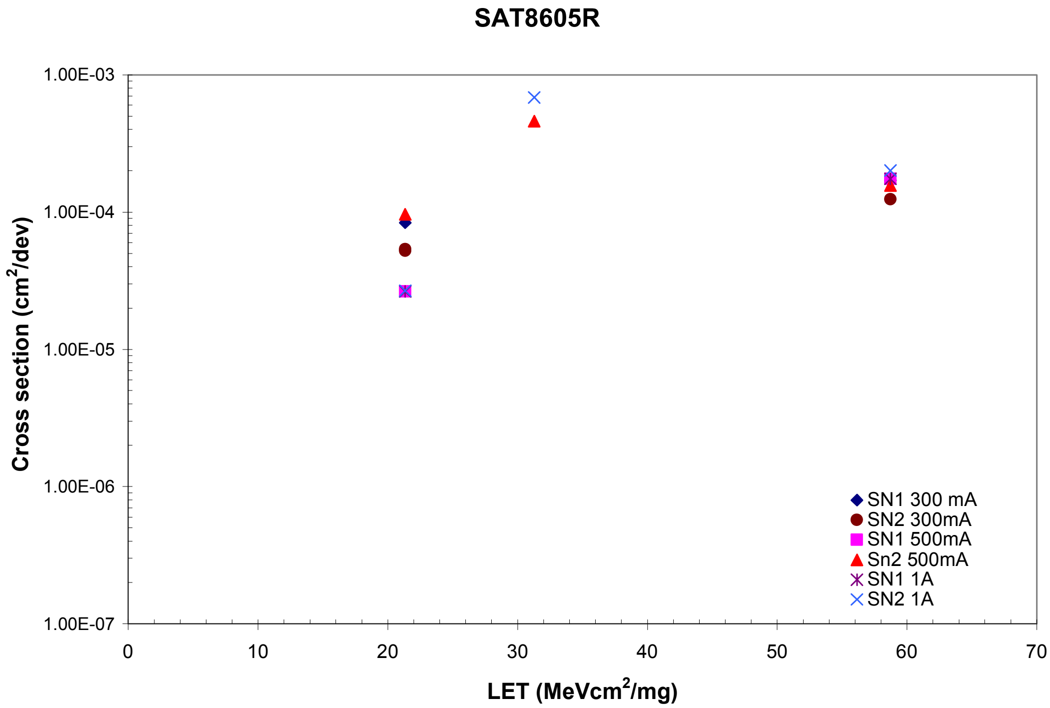

Figure 3: SET cross-section curves

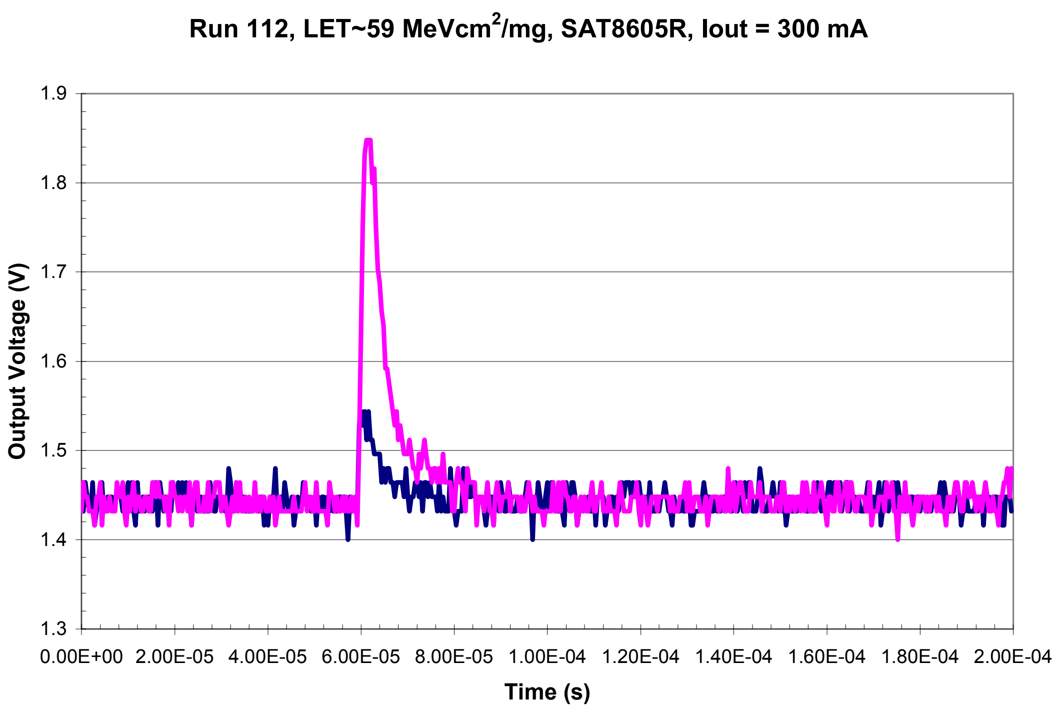

Figure 4: Typical SET waveforms

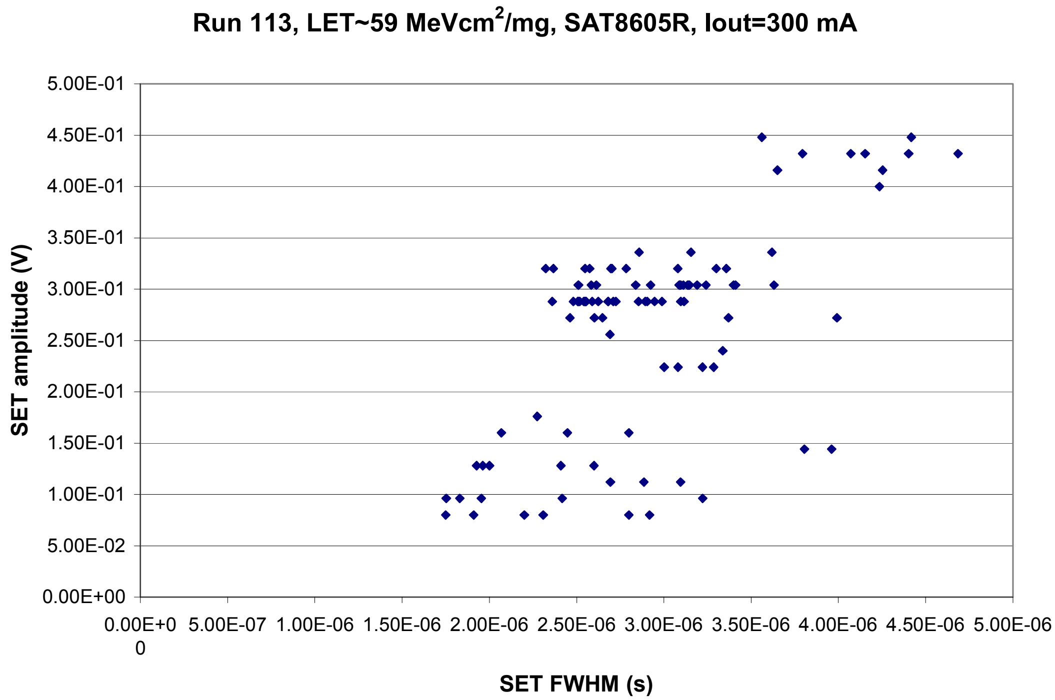

Figure 5: SET amplitude versus width plot for all transients observed during run 113